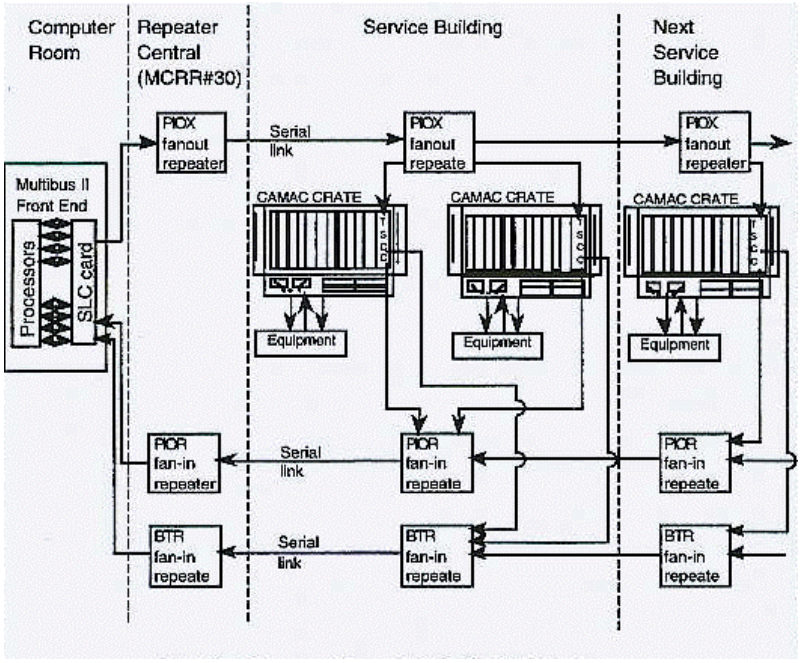
CHAPTER 7

Controls

In order for Operations to monitor and control all of the hardware throughout the Tevatron a means of communication is required to bring information to the Main Control Room. The "links" are what provide this communication. There are several links associated with the TeV and a variety of transmission media, hardware, and software is used for each. The most common link is the CAMAC link. Other links are the QPM, TVLLRF, Refrigerator, HLRF, and Abort.

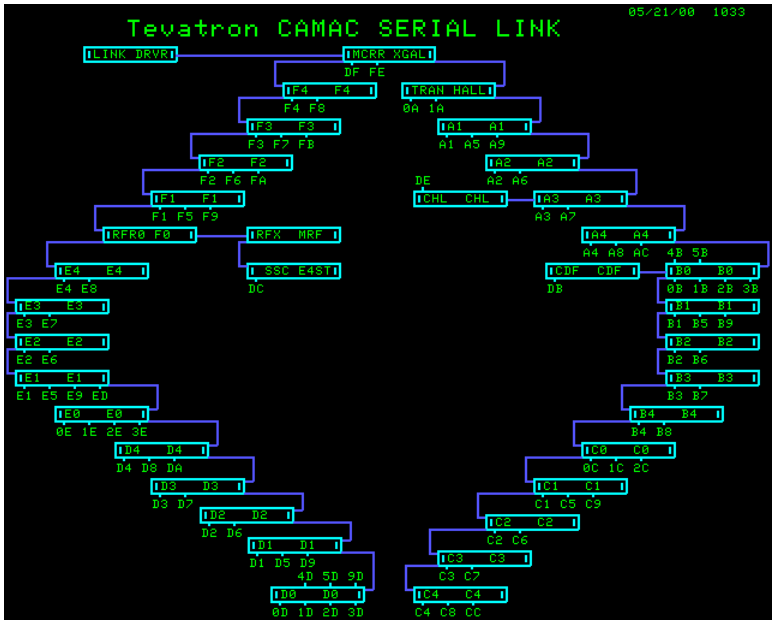
CAMAC Link & Cards

CAMAC is an acronym for "Computer Automated Monitor and Control." The associated hardware are a Multibus II front end (MB II FE), 19-conductor cable, crates, repeaters, and specialized cards.



The CAMAC link is generated by the Serial Link Controller card that resides in the MB II FE located in the computer room. Three links are associated with each FE. The first is PIOX, or the transmission link. Requests for information originate at the FE and are sent via the repeaters throughout the link, where they are decoded by the appropriate CAMAC crate. The second link is PIOR, also known as the receiving link, provides the replies of requests to the FE. The third link is BTR, or block transfer. The BTR link allows large amounts of data to be sent to the FE without interruption, such as for fast time plots.

From the SLC card the next step in the link is repeater central, located in Rack #30 in the MCR. From there the link divides with one branch going from F4 to D0 and the other from Transfer Gallery to C4. See the diagram below for the TeV link layout.



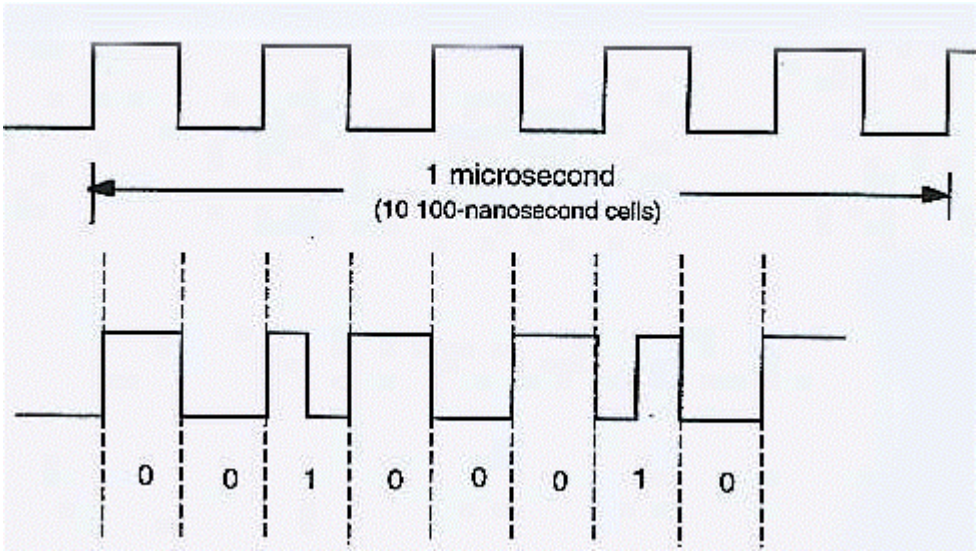
The link uses a 19-conductor heliax cable to propagate the signals. The cable can be seen fanning out from a large junction box attached to the ceiling of each service building. Since the Tevatron ring circumference is 4 miles, the electrical signal broadcast onto the link would normally have degraded by the time it reached the furthest service buildings. This is why repeaters are found at each service building. They boost the signal at regular intervals. Repeater cards are housed in half-high NIM crates.

Each CAMAC crate has a unique address, which is expressed in hexadecimal. Note the addresses in the picture of the serial link above. Within each crate is the Tevatron Serial Crate Controller (TSCC) card that resides in the 2 leftmost slots of the 25 slots available. The TSCC decodes the addresses within the transmissions on the link so that when it detects its own address the data is routed to the intended specialized card.

The CAMAC cards in each crate are the most extensive part of the CAMAC system. The cards can have a variety of functions. Some may be timing cards while others are ramp controllers. A listing and function of the most commonly used cards will follow later.

So how does the communication work. The FE has a 386 processor that uses an 8 bit parallel bus for data manipulation. In order to avoid burying miles of ribbon cable, a serial format to the data was a better choice and only one cable would be needed for the link. The SLC card converts the parallel data into the serial format. Along with the data an eight bit crate address, a subaddress for the card, and two parity bits are added to the data stream. The TSCC card decodes the address, converts the serial format back to eight bits parallel format, and passes it to the appropriate card.

The transmission rate is 10 MHz and is coded as a square wave that alternates between 0 and 2 volts. The square wave is interpreted by the hardware as consisting of "cells" 100 nanoseconds long. If the voltage remains constant for the full lifetime of the cell, the bit is interpreted as a zero. It doesn't matter if the voltage is high or low. If the voltage makes a transition from one state to another in the middle of the cell, then the bit is interpreted as a one.



Abort Link

The Tevatron has kickers that remove beam either at the end of a machine cycle or during an unexpected occurrence. The abort loop monitors certain devices and if they fail then the beam is instantaneously removed from the machine. For beam to be permitted in the TeV the abort loop has to be continuous. If a failure occurs the loop is broken and the beam is kicked out of the machine.

In addition to the abort dump at C0, there is an internal dump located in the Transfer Hall, which is used during Collider operations. When antiprotons are in the Tevatron both protons and pbars are aborted into this dump. Since the intensities during Collider operation are relatively low this enclosure dump can be used.

The abort loop utilizes one of the 19 conductor cables. The link must have a 50 MHz signal present on it for the loop to be up. The 50 MHz signal is generated by a CAMAC 201 module housed in a crate at the C0 service building. The loop circles the ring where at every service building it encounters 200 module which can inhibit the transmission of the signal if a monitored device goes into a bad state. The 200 module is known as the

abort concentrator and it accepts a maximum of 8 inputs. Behind the CAMAC crate that houses the 200 module is the abort patch panel which has the input cables for those devices to be monitored. Below the line of spigots for the abort inputs is another row of spigots labeled "current sources." The 200 module interprets the presence of current as "good" or "1". If the device input signal or current source is absent then the abort module will interrupt the 50 MHz signal and take down the loop. Device inputs can be jumpered using the current sources.

When an abort reset is sent from T67, the Abort Link Status page, the CAMAC 201 module is told to initiate the 50 MHz signal. The signal takes roughly 34 μsec to traverse the ring if all is well. If the 201 module does not detect the signal within 100 μsec then the card will cease transmitting and wait for the next reset to be issued.

The majority of the abort inputs will immediately remove beam when pulled. These are "Type 0" aborts. This group includes the dipoles, correction elements, low beta quads, and the Tevatron ramp itself via the A2 TECAR input. The QPM's will issue an abort in the event of quench or ramp dump. The BLM's generate an abort if losses are too high and vacuum crates will cause an abort if a beam valve closes. The 200 module in the MCR has inputs from the manual abort buttons and the safety system.